5. DuBost C, Carpentier A, Sellier P, et al. Emergency myocardial revascularization. Postgrad Med J 1976; 52:743.
6. Golding LAR, Loop FD, Sheldon WC, et al. Emergency revascularization for unstable angina. Circulation 1978; 58:6.
7. Langou RA, Wiles JC, Cohen LS. Coronary surgery for unstable angina pectoris: Incidence and mortality of perioperative myocardial infarction. Br Heart J 1978; 40:767.
8. Langou RA, Geha AS, Hammond GL, Cohen LS. Surgical approach for patients with unstable angina pectoris: Role of the response to initial medical therapy and intraaortic balloon pumping in perioperative complications after aortocoronary bypass grafting. Am J Cardiol 1978; 42:629.
9. Olinger GN, Bonchek LI, Keelan MH, et al. Unstable angina: the case for operation. Am J Cardiol 1978; 42:634.
10. Pugh B, Platt M, Mills L, et al. Unstable angina pectoris: a randomized study of patients treated medically and surgically. Am J Cardiol 1978; 41:1291.
11. Unstable angina pectoris: National Cooperative Study Group to compare surgical and medical therapy: II. In-hospital experience and initial follow-up results in patients with one, two and three vessel disease. Am J Cardiol 1978; 42:839.

Discussion

Dr. Denton A. Cooley (Houston, Texas): One would expect unstable angina to have a higher operative, in-hospital risk than stable angina because it usually reflects a more extensive and extending type of coronary insufficiency. Therefore, his comparative rates of 2% versus 7% are not too disturbing to me.

After reviewing his paper, I believe they employ a more liberal use of preoperative intra-aortic balloon pumping than we do in our institution. In general, we believe the introduction of the balloon pump as a second procedure or as a stage in the preparation of the patient for myocardial revascularization is unnecessary and might be detrimental to the patient. Therefore, we would prefer to use a more direct approach, and take the patient to the operating room and then decide whether the balloon assist was appropriate postoperatively.

It is interesting to note, however, that patients with unstable angina seem to have the same type of long-term outlook and prognosis as patients with stable angina. Among our own patients, a series of patients was collected by one of our cardiology groups who found that at the end of five years 93% of the entire group, and 91% of the unstable angina group, were surviving. It does indicate that these patients have a good prognosis, or as good as that of patients with stable angina at the end of the five-year period.

Recently, we surgeons have been plagued by some of the federally supported, so-called random studies which have reflected that surgery does not have any influence on long-term survival. For example, in the Veterans Hospital survey of stable angina, at the end of three years there was an 87% survival among the surgical patients and an 88% survival among those treated medically.

In another cooperative study of unstable angina, the results revealed similar findings in survival.

Among our patients, who included all of the surgical patients, we found a cumulative mortality, or attrition, of 2.46% per year over a five-year period; and in these patients with unstable angina, 2.44% per year. Therefore, it would seem reasonable to operate on patients with unstable angina.

In fact, I would like to ask Dr. Brawley if he has a cutoff period in terms of age or risk/benefit ratio for his patients, and would he be in a position to deny some patients operation when they have uncontrollable angina pectoris?

Dr. Ellis Jones (Atlanta, Georgia): The management of unstable angina at Emory University Hospital is quite different from that described by Dr. Brawley. The protocol for management of unstable angina, as Dr. Brawley has mentioned—namely, the studying by cardiac catheterization of only those patients who are refractory to the most intensive medical management—assures that only the highest risk patients will receive surgical benefit. We believe this philosophy is wrong, for several reasons.

First, unless an aggressive posture is taken, many cases of left main stenosis will be missed at the initial time of presentation. Second, there will be a significant incidence of hospital readmission at some subsequent date for recurrent unstable angina pectoris. Third, during this interim period there is always the risk of sudden death or infarction, with significant myocardial muscle damage. Fourth and finally, it's hard to rationalize this cardiologic approach to the management of unstable angina in the young patient, when the risk of a subsequent serious cardiac event is almost certain.

Our approach has been to offer cardiac catheterization to almost all patients with unstable angina admitted to the coronary care unit. This means that approximately 70% of these patients will be acceptable candidates for revascularization and will undergo surgery. Another 10% will have had an occult myocardial infarction, and another 20% will not be offered surgery for various reasons.

Another significant difference in our series over that of the one presented is that we do not require the presence of EKG changes with pain for the diagnosis of unstable angina pectoris. I think the finding of these changes sometimes depends on how many EKG's are performed in the coronary care unit.

Although for this reason we do not have a group of patients exactly comparable to that of the authors, hospital mortality is influenced by abnormal ST-T changes on EKG.

(slide) The lower portion of this slide depicts the hospital mortality determined by the presence of abnormal ST-T segments. If the ST-T segments were isoelectric, there is a 1% hospital mortality; if there was depression, 3.1%; but if the ST-T segments were elevated, there was a 5.9% hospital mortality. These mortality figures may not be truly representative of our recent experience, because between the years 1976 and 1979 3040 patients received coronary bypass with 25 deaths, a hospital mortality of 0.8%.

An interesting group of patients which may reflect indirectly on today's presentation are those having myocardial revascularization within 30 days of infarction. (slide) This we would consider a truly unstable group of patients. There were 155 patients having revascularization within 30 days of infarction. There was about an equal incidence of transmural and subendocardial damage. Ejection fraction less than 40%, as Dr. Brawley mentioned, was present in 13%. The postoperative course was characterized by a high incidence of use of i.v. nitroglycerin, inotropes, but only a 1.6 perioperative incidence of intra-aortic balloon pumping. The interesting finding in this series was that there were no hospital deaths in the 155 patients.

We would disagree with the frequency, as Dr. Cooley has mentioned, of preoperative intra-aortic balloon counterpulsation used by the authors. An incidence of almost 17% seems too high, and may reflect less than optimal pharmacologic and anesthetic support prior to and shortly after induction of anesthesia.

Dr. Brawley has stated in his closing remarks that patients with unstable angina can be done with a low mortality rate, provided these patients are good candidates for operation. Unfortunately, under the present protocol established by the Hopkins cardiologists, the candidates for operation will continue to have a very high incidence of poor distal vessels, bad left ventricular function, left main stenosis, and will by definition have a higher mortality rate.

I have just one question for Dr. Brawley: Was nitroglycerin used in the prebypass and perioperative period?

Dr. Clarence S. Thomas, Jr. (Nashville, Tennessee): I think it bears comment that the crux of this presentation to many of us

is that it represents a quantum improvement in results in the treatment of unstable angina by the surgical group at Johns Hopkins, and we all welcome this improvement; not that that means in any way to be derogatory, but that we would very much appreciate the opportunity to learn some of the lessons that they have learned in the process of so doing.

About a year or so ago, Dr. Kirklin described the experience at that point with the unstable angina cooperative group, of which Johns Hopkins is a member. At that time he pointed out that the major factors affecting operative risk in some of the institutions involved in that study had to do with the subject that Dr. Jones just alluded to; that is, the prebypass, intraoperative anesthetic management of these individuals.

I'd like, then, to ask Dr. Brawley if some of the lessons that they have accrued in this excellent and improving experience could be passed along to us.

DR. ROBERT K. BRAWLEY (Closing discussion): Let me begin by making some comments on the use of balloon counterpulsation. The intra-aortic balloon was used preoperatively in 22 of the 130 patients in this series. In ten patients the indication for that device was refractory unstable angina; that is, angina occurring either at rest or with minimal exertion in a patient who had a severe obstruction of the main left coronary artery. We consider this combination to be particularly dangerous during the period between induction of anesthesia and the establishment of cardiopulmonary bypass. We have used the balloon liberally in this type of patient. In 12 other patients the intra-aortic balloon was inserted preoperatively because of the inability of our cardiologists to control angina with maximum medical therapy given to patients in the intensive care area. Ordinarily, balloon counterpulsation will immediately relieve angina and produce a stable patient. We consider these 22 patients to be the most unstable of the entire group and only 1 of the 22 patients died postoperatively. There were no serious complications attributable to the use of the balloon in this series. Thus, we continue to feel that the balloon is a helpful adjunct.

Our use of the intra-aortic balloon has diminished with improvement of our anesthesia techniques during the period between induction of anesthesia and establishment of cardiopulmonary bypass. In the past an important factor in our frequent use of the intra-aortic balloon was the difficulty we had in maintaining hemodynamic stability in patients with unstable angina during this particularly vulnerable period.

I want to compliment Dr. Jones for his excellent results. We use nitroglycerin extensively during the induction of anesthesia, prior to cardiopulmonary bypass, and also postoperatively in many, many patients. This drug has been a big help, I think, and one of the factors that has allowed us to improve our results.

Dr. Thomas, I believe the major factor in the improvement of results at our institution in patients with unstable angina pectoris is that we no longer operate on these patients as emergencies. Our initial experience with patients operated on for unstable angina included a number of patients who underwent emergency operation. Operative mortality was unacceptably high during that early period. I believe that if the patient can be stabilized with the intra-aortic balloon or with medical therapy and operated on semielectively when you have excluded myocardial infarction, the results will be better.

Dr. Cooley's question is to me one of the most important. We are now able to recognize patients who are good candidates and patients who are poor candidates for bypass operation, whether they have stable angina pectoria or unstable angina pectoris. Should we offer operation to those patients that we know have a high operative risk? Our answer has been: Yes, we should offer operation to them, although we recognize that the operative mortality in some of these groups may be very high. Usually, these are patients who are absolutely refractory to medical therapy. Frequently, our cardiologists are unable to get them out of the Coronary Care Unit, despite maximal medical therapy and there seems really to be little else to do with them.